IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF GEORGIA
ATLANTA DIVISION

ANTHONY WILSON and KIMBERLY WILSON, the parents of Martez Wilson, and the ESTATE of MARTEZ WILSON, Plaintiffs, v. CITY OF DOUGLASVILLE, GA, et al., Defendants.	CIVIL ACTION FILE NO. 1:17-cv-00634-ELR

DECLARATION OF DR. KRIS L. SPERRY

I, DR. KRIS L. SPERRY, hereby declare as follows:

1. My name is DR KRIS L. SPERRY. I have owned and operated Sperry Forensic Pathology Consultants, Inc. for twenty-one years.

2. I became a board-certified forensic pathologist in 1986.

3. I served as Chief Medical Examiner of the State of Georgia through the Georgia Bureau of Investigation Division of Forensic Sciences for eighteen years before retiring in November, 2015. Prior to that, I was Deputy Chief Medical Examiner for Fulton County Medical Examiners' Office, where I was employed for eight years.

EXHIBIT "10"

4. I have been involved in over 90,000 autopsies throughout my career, performing over 6,600 of those myself. I have personally performed approximately five or six autopsies of individuals who died from complications of Sickle Cell Trait. In addition, I have performed many autopsies on persons who, although they were carriers of the sickle cell trait, died from causes unrelated to that condition.

5. As a forensic pathologist, it is necessary for me to ascertain the cause of death for persons whose cases I have worked on. Once we understand the physiological mechanism by which a person has died, my training and experience enables me to draw conclusions as to the type of medical techniques or interventions which, if they had been undertaken, would have had an impact upon the mechanisms and the likelihood of death. As a result of this training and experience, during the course of my practice as a forensic pathologist, from time to time I have been called upon to provide expert testimony as to the survivability of a particular person whose case I have studied. I have provided survivability testimony in the context of numerous medical conditions, including gunshot and stab wounds, embolisms, and physiologic and electrolyte derangements.

6. During the course of my association with the Wilson matter I reviewed the autopsy performed on Martez Wilson on March 3, 2015, by the Medical Examiner's Office in the Georgia Bureau of Investigation.

7. The GBI autopsy ascribed the cause of death to: "Exercise-induced sickle cell crisis in an individual with sickle cell trait (ECAST)." "ECAST" is an abbreviation for "Exercise Collapse Associated with Sickle Cell Trait."

8. The autopsy revealed scattered small, superficial abrasions on various body surfaces and the extremities, but no evidence of any significant trauma, or of grossly apparent natural disease that could account for Mr. Wilson's death. All of the body organs were or normal weight and configuration.

9. Postmortem vitreous chemistry disclosed a mildly elevated Sodium, at 151 meq/L. This indicates that Mr. Wilson was mildly dehydrated.

10. The autopsy indicated that the cerebral cortex of the brain appeared "dusky." This discoloration of the brain is an indicator of insufficient oxygenation of the brain.

11. The hemoglobin electrophoresis results in the autopsy revealed a pattern consistent with sickle cell trait; Hgb A 55%, Hgb S 40%, Hgb F 1.3%, and Hgb A2 3.5%. Microscopic examination of heart, lung, brain, kidney, liver, and spleen tissues revealed that most of the red blood cells were sickled in shape. However, the specific timing of the onset of sickling of Mr.

Wilson's blood cells in relation to the point at which Mr. Wilson actually died cannot be conclusively determined. When persons who carry the sickle cell trait die, their red blood cells will sickle because of the associated lack of oxygen, regardless of the specific cause of death.

12. I am in agreement with the findings and conclusions of the GBI autopsy.

13. Sudden deaths arising in individuals who have previously undiagnosed and/or unsuspected sickle cell trait are known to occur in settings where such individuals have been involved in some sort of strenuous exercise or physical exertion shortly prior to becoming ill.

14. The medical literature exploring ECAST events indicate that systemic acidosis (lowering of the blood pH) and increases in lactic acid produced by muscular exertion are thought to initiate the red cells within the blood that contain a high percentage of Hgb S to begin to "sickle," as the abnormal hemoglobin assumes a linked chemical structure that deforms the usually biconcave disk shape of the red cells.

15. This sickling interferes with the normal blood flow at a microscopic (capillary) level within the body, causing the blood to thicken, often to a "sludgy" consistency, impeding both blood flow and oxygen delivery to tissues and organs throughout the body.

16. ECAST events are usually accompanied by some degree of dehydration, relating to the exertion that precedes symptoms and eventual deterioration.

17. This dehydration causes an additional increase in the viscosity of the blood and thus increases the propensity for the blood to not flow as well through the body.

18. When this thickening of the blood occurs, the individual may manifest cardiac rhythm disturbances, inability to oxygenate the blood in the lungs, and impaired cerebral functioning (which may then cause unresponsiveness and unconsciousness).

19. It appears that Mr. Wilson was exhibiting signs of impaired cerebral functioning during his encounter with the Douglasville Police Department.

20. According to the audio portion of the video from the officers' dashboard camera, Mr. Wilson also complained numerous times of not being able to breathe. Prior to being placed within the vehicle, Mr. Wilson stated, "I can't breathe" multiple separate times over the course of just over two minutes.

21. Mr. Wilson's cerebral functioning appears to have deteriorated in the period of time between the initial contact made with him by the first of the Douglasville officers up until EMS arrived on the scene. The law enforcement officers at the site of Wilson's arrest reported that when they first got to Wilson he was talking, but thereafter ceased speaking.

22. The officers also reported that Wilson said that he could not walk and that they had to carry Wilson to the police car. The decline in Wilson's speaking and decline in his ability to move on his own are symptoms that are consistent with impairment of blood flow to his brain.

23. It is my opinion, to a reasonable degree of medical certainty, that if Mr. Wilson had been promptly supplied with oxygen and fluids at the site of his arrest and promptly transported to an Emergency Room by the responding medical personnel, that more probably than not, he would have survived. There is data pertinent to patients who present to Emergency Departments which address the prospect of a favorable outcome for a patient if they are transported to Emergency Departments. According to the attached article, appearing in "Health Affairs" in 2016 (Kanzaria HK, Probst MA, Hsia RY. Emergency Department Death Rates Dropped by Nearly 50 Percent, 1997-2011), *Health Aff.* 2016; 35(7): 1303-1308 and https://cdc.gov/nchs/data/ahcd/nhamcs_emergency 2011_ed_ed_web_tables.pdf) the overall mortality rate of patients who present to the emergency department alive (i.e., with measurable vital signs such as respiratory rate, blood pressure, and heart rate) is less than 1%. As we know, even though they did not record his blood pressure, EMS

personnel who were present with Mr. Wilson prior to his death reported that he had measurable respiratory rate and heart rate.

24. Mr. Wilson made multiple complaints of not being able to breathe. If he received oxygen treatment during the time of his complaints, systemic hypoxia [the low concentration of oxygen in his blood and tissues] could have been avoided.

25. Administration of fluids would have increased the overall perfusion of blood throughout the body, reversing Mr. Wilson's dehydration and ameliorating the increased blood viscosity and the clumping caused by sickled cells. The administration of fluids could have assisted in stabilizing Wilson.

26. Administration of oxygen would have increased the delivery of oxygen to Wilson's tissues, including his brain, and assist in stabilizing him. Indeed, the administration of oxygen to Wilson would have been of even greater importance from a survivability standpoint than would the administration of fluids. Keeping the red blood cells oxygenated would have been the lynchpin to Wilson's stabilization and survivability while still in the field prior to his transport to an Emergency Department.

27. The administration of oxygen would have been fully appropriate for a patient complaining of inability to breathe, regardless of whether the patient

was known to carry the sickle trait. The administration of fluids and oxygen would have reduced the likelihood of Wilson's death and increased the likelihood of Wilson's survival, regardless of whether the EMS personnel were aware of Wilson's underlying medical condition, including the fact that he carried the sickle cell trait. The prospect for a successful outcome for Mr. Wilson would have been greater the earlier such interventions were undertaken.

28. Stabilization of Mr. Wilson would have vastly increased the possibility that he would have arrived at a nearby Emergency Department alive. According to EMS personnel, the nearest hospital to the site of the arrest was two or three miles away and it would have taken only about five minutes to transport Wilson. If EMS had transported Mr. Wilson to an emergency room, hospital personnel would have quickly performed a standard work-up for patients who are inadequately responsive and exhibiting cardio-respiratory distress, moving through a series of escalating interventions.

29. This work-up would have included promptly administering oxygen and IV fluids, performing an EKG, measuring oxygen saturation with a pulse oximeter and blood gas, measuring blood pH, intubating if oxygen saturation was low and giving bicarbonate to alleviate acidosis.

30. The primary goal of early intervention in an ECAST event is to prevent systemic acidosis and rhabdomyolysis, death of skeletal muscle cells with a concomitant release of muscle proteins into the blood that plug up the kidneys and stop the kidneys from functioning.

31. Defendants' expert witness Dr. Carlton Dampier has expressed the opinion that there is no possible way to predict survivability of persons experiencing ECAST events due to the absence of clinical trials involving ECAST events. However, there is a good reason that such clinical trials are not undertaken.

32. I agree with Dr. Dampier that it would be unethical to conduct clinical trials attempting to induce exercise-related collapse (ECAST) among trial participants with sickle cell trait due to the unacceptable risk of harm to participants in such trials.

33. I do not agree with Dr. Dampier that the absence of such trials makes it impossible to opine as to survivability of an ECAST event. The medical literature upon which I based my opinions reflects the techniques which have been proven to prevent ECAST related deaths. This literature provides treatment recommendations, which include the provision of oxygen and administration of fluids, that are based on the outcome of several studies aimed at reducing and preventing deaths from ECAST. (Quattrone, R. D.,

Eichner, E. R., Beutler, A., Adams, W. B., & O'Connor, F. G. Exercise Collapse Associated With Sickle Cell Trait (ECAST): case report and literature review. *Current Sports Medicine Reports* 2015; 14(2): 110-116.); O'Connor, F. G., Bergeron, M. F., Cantrell, J., Connes, P., Harmon, K. G., Ivy, E., ... & O'Brien, K. ACSM and CHAMP Summit On Sickle Cell Trait: Mitigating Risks For Warfighters And Athletes. *Medicine and Science in Sports and Exercise* 2012; 44(11): 2045-2056.; Tsaras, G., Owusu-Ansah, A., Boateng, F.O., & Amoateng-Adjepong, Y. Complications Associated With Sickle Cell Trait: A Brief Narrative Review. *The American Journal of Medicine* 2009; 122(6): 507-512).

34. One of the studies described in O'Connor, et.al., in the ACSM and CHAMP Summit article referred to above was particularly noteworthy. It described a major undertaking by the U.S. Army to assess whether the occurrence of ECAST-like incidents in the military recruit population were mitigated by enforcing strategies to prevent Exertional Heat Illness. The Army study compared the rates of death among recruits [with and without the sickle cell trait (SCT)] to whom the prevention strategies were applied [described as the intervention group] with the rates of death among other recruits [described as the nonintervention group]. Between 1982 and 1991, an intervention group (30,000 regular military recruits with SCT and 1.8

million without SCT) and a nonintervention group (consisting of 13,500 recruits with SCT and 960,000 without SCT) were followed. In the intervention group, immediate cooling and rehydration were provided for recruits who had 'fallen out' during exertional training events. No recruits with SCT from the intervention group died. In contrast, four deaths of persons with SCT occurred in the nonintervention group.

I declare under penalty of perjury that the foregoing statements are true and correct.

Executed on December 17, 2018 Signature _____

DR. KRIS L. SPERRY

By Hemal K. Kanzaria, Marc A. Probst, and Renee Y. Hsia

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DATAWATCH

Emergency Department Death Rates Dropped By Nearly 50 Percent, 1997–2011

Between 1997 and 2011, there was a nearly 50 percent reduction in US emergency department mortality rates for adults. This trend likely has many causes, related to advances in palliative, prehospital, and emergency care.

The core mission of emergency medicine is to provide immediate care to acutely ill and injured patients. The emergency department (ED) also serves as a safety net, allowing patients to access care when other avenues fail.[1] The ED is often where end-of-life care occurs for patients with either unexpected fatal conditions or acute complications of terminal illness. In fact, over half of older Americans visit the ED in their last month of life.[2,3] Such visits are taxing for patients, caregivers, and providers and contribute to high end-of-life health care costs. The following question thus naturally arises: How often do adult patients die in the ED?

Despite existing literature on the relationship between ED care and subsequent mortality for selected conditions, little is known about trends in mortality in the ED. Recent efforts in the fields of palliative and prehospital care have sought to shift the locus of death, when feasible, to more appropriate settings. Meanwhile, recent advances in emergency critical care have sought to decrease mortality from immediately life-threatening conditions. Between 1997 and 2011 there was a nearly 50 percent reduction in US adult ED mortality rates (Exhibit 1). Assessing trends in ED mortality rates may help illuminate the impact of these efforts by offering a perspective on where patients are dying. Thus, we sought to describe national trends in US ED mortality and visit rates and to delineate demographic and clinical factors associated with ED death.

Study Data And Methods

DATA To evaluate adult ED mortality rates in the United States, we analyzed ED visit data from the

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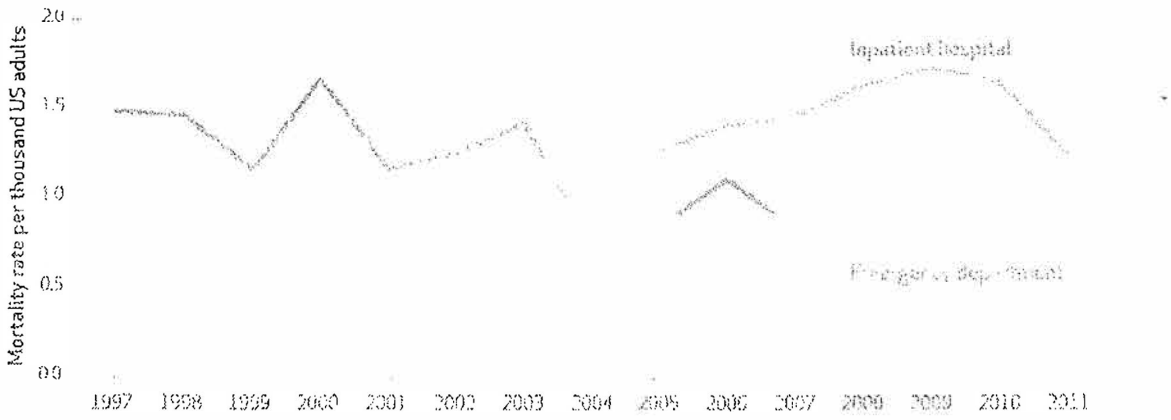
EXHIBIT 1

Trends in emergency department and inpatient hospital mortality



SOURCE Authors' analysis of data for 1997–2011 from the National Hospital Ambulatory Medical Care Survey (NHAMCS). **NOTES** Mortality rates are per thousand US adults ages eighteen and older. NHAMCS data for inpatient hospital mortality became available only starting in 2005. Appendix Exhibit 1 (see Note 4 in text) is a table containing pertinent data points, standard errors, confidence intervals, and other statistical data for this exhibit.

National Hospital Ambulatory Medical Care Survey (NHAMCS) from 1997 to 2011, the most recent year for which data are available. Detailed information about NHAMCS and our study methods can be found in the online Appendix.[4] Briefly, NHAMCS is an annual national probability sample survey of ED visits in nonfederal, general, and short-stay hospitals conducted by the National Center for Health Statistics (NCHS). A multistage sampling procedure facilitates unbiased national estimates of ED visits, and the survey also includes data on patients' demographic characteristics, reasons for the visits, and mortality.[5–9]

ANALYSES Our analysis included all ED visits by adults ages eighteen and older throughout the fifteen-year study period. Data were stratified by age, sex, race/ethnicity, insurance status, triage category, urbanicity, geographic region, and whether there had been a recent ED visit or hospitalization.

The primary outcome was annual ED mortality rate per thousand US adults, calculated using denominator estimates from the US Census Bureau. NHAMCS data abstractors grouped patients who died in the ED and those who were dead on arrival together for the period 1997–2006 but coded them separately for the period 2007–11. However, there were no definitional changes to either of these terms.[6–9] Thus, consistent with previous literature[1] and NCHS standards, we included in ED deaths both patients who died in the ED and those who were dead on arrival.

We report unweighted visit and mortality data, survey-weighted national estimates, and 95 percent confidence intervals. To evaluate longitudinal changes, we performed survey-weighted trend analysis using weighted least squares regression. For comparison, we also analyzed inpatient hospital mortality rates from 2005 (when these data became available) to 2011. We additionally examined primary "reason for visit" data associated with ED mortality. Finally, we evaluated trends in patient and visit characteristics over the entire study period, specifically assessing changes in ED visit rates and the proportion of ED visits by characteristic.

This study was deemed exempt from review by the Institutional Review Board of the University of California, San Francisco.

LIMITATIONS Our study had several limitations. First, while we propose possible explanations for our findings, our study generated only hypotheses. We were unable to test which causative factors were responsible for the observed trends.

Second, as with most research data sets, NHAMCS is imperfect and likely has inherent limitations related to, for example, changes in data abstraction or coding practices over time. Our methodology follows suggested NCHS guidelines to limit potential shortcomings and is detailed in the Appendix.[4] Moreover, NHAMCS is the largest nationally representative data set that provides epidemiologic data on emergency conditions in the United States, and it remains one of the most widely used resources for research on emergency medicine health services.

Study Results

We examined 367,618 observations, which represented 1.3 billion ED visits across the United States. Compared to patients who survived to ED discharge or hospital admission, those who suffered ED death were on average older, more likely to be male and white, and had more severe triage acuity scores. In addition, the proportion of patients visiting a rural ED, or an ED in the South region of the country, was higher in patients who died compared to those who survived (Exhibit 2).

ED mortality rates decreased from 1.48 per thousand in 1997 to 0.77 per thousand US adults in 2011—a 48 percent reduction (Exhibit 1). There was no significant change in inpatient hospital mortality from 2005 to 2011, even though the rate peaked in 2009.

For 62.7 percent of the ED visits in which patients died, patients were noted to be in cardiopulmonary arrest, unconscious, or dead on arrival (data not shown). The most common reasons for an ED visit for the remaining patients who suffered ED death were shortness of breath (accounting for 8.3 percent of the visits), injury (5.1 percent), and chest pain (3.9 percent).

Visits by non-Hispanic black patients and Medicaid recipients accounted for the greatest increase in ED visits from 1997 to 2011, after US population growth was controlled for (Exhibit 3). A lower proportion of ED visits were triaged as requiring immediate or emergent care in 2011 (13.2 percent) than in 1997 (22.7 percent) (Exhibit 4). Among US adults with Medicare or Medicaid, the ED visit rate per thousand enrollees also increased substantially between 1997 and 2011, from 405.1 to 534.6 for Medicare and from 646.2 to 863.4 for Medicaid (Exhibit 5). Trends, stratified by ED survivors and nonsurvivors, can be found in the online Appendix.[4]

Discussion

To our knowledge, there has been no previous national study evaluating longitudinal trends in ED mortality. There are several possible explan-

EXHIBIT 2

Characteristics of US adults ages 18 and older who visited a hospital emergency department (ED), 1977–2011

	Dead on arrival or died in ED			Survived ED visit		
Characteristic	Unweighted no.	Weighted %	95% CI	Unweighted no.	Weighted %	95% CI
Total	974	0.3		366,644	99.7	
Age (years)***						
18–44	154	14.7	11.7, 17.7	201,007	54.7	54.2, 55.2
45–64	271	26.8	23.3, 30.3	94,770	25.6	25.3, 25.9
65–79	278	30.7	27.2, 34.2	43,088	11.9	11.6, 12.2
80 or older	271	27.7	24.0, 31.4	27,779	7.7	7.4, 8.0
Sex***						
Female	413	44.0	40.1, 47.9	204,028	56.2	55.9, 56.5
Male	561	56.0	52.1, 59.9	162,616	43.8	43.5, 44.1
Race/ethnicity***						
Non-Hispanic white	671	71.3	67.0, 75.6	231,889	66.2	64.5, 67.9
Non-Hispanic black	193	20.1	16.4, 23.8	78,500	20.7	19.1, 22.3
Hispanic	79	6.4	4.4, 8.4	43,112	10.4	9.4, 11.4
Other	31	2.2	1.0, 3.4	13,143	2.7	2.2, 3.2
Insurance***						
Private	178	17.3	14.4, 20.2	121,152	33.9	33.1, 34.7
Medicare	462	50.5	46.4, 54.6	75,991	21.2	20.6, 21.7
Medicaid	78	8.0	5.8, 10.2	61,955	15.4	14.7, 16.0
Uninsured	144	13.7	10.9, 16.4	64,928	18.3	17.5, 19.1
Other	—[a]	—[b]	—[b]	21,280	5.0	4.7, 5.4
Missing or unknown	83	7.3	5.3, 9.3	21,330	5.5	4.9, 6.1
Triage category***						
Immediate or emergent	696	72.1	68.1, 76.1	61,848	16.9	15.9, 17.9
Urgent	89	9.6	6.7, 12.5	136,574	37.4	36.2, 38.6
Semi-urgent or nonurgent	34	3.0	1.5, 4.6	110,708	30.3	28.9, 31.7
No triage or unknown	155	15.3	12.1, 18.5	57,514	15.3	13.8, 16.8
Region**						
Northeast	212	17.3	14.1, 20.5	92,942	19.6	17.2, 22.0
Midwest	212	23.8	19.9, 27.7	78,312	23.5	20.3, 26.7
South	395	45.0	40.1, 49.9	123,516	38.4	34.5, 42.3
West	155	13.8	11.1, 16.5	71,874	18.5	15.8, 21.2
Metropolitan Statistical Area**						
Urban	807	77.0	69.7, 84.3	315,578	81.7	75.9, 87.5
Rural	167	23.0	15.7, 30.3	51,066	18.3	12.6, 24.0
Seen in the same ED within 72 hours before visit[c] ***						
Yes	—[a]	—[b]	—[b]	11,016	3.8	3.6, 4.0
No	561	76.4	71.5, 81.3	248,474	83.2	81.4, 85.0
Unknown	139	21.8	16.9, 26.7	37,484	13.0	11.2, 14.8
Discharged from hospital within 7 days before visit[c] ***						
Yes	—[a]	—[b]	—[b]	5,118	2.6	2.4, 2.8
No	206	47.8	40.6, 55.0	112,353	60.3	56.9, 63.7
Unknown	178	49.8	42.6, 57.0	66,699	37.1	33.7, 40.5

SOURCE Authors' analysis of data for 1997–2011 from the National Hospital Ambulatory Medical Care Survey. NOTE CI is confidence interval. [a]Fewer than thirty visits. [b]Not reliable because thirty or fewer visits. [c]Data from 2001–11 only. [d]Data from 2005–11 only. **$p < 0.05$ ***$p < 0.01$ ***$p < 0.001$

ations for the substantial downward trend—a drop of nearly 50 percent—in ED mortality that warrant further review.

First, it is possible that although fewer are dying in the ED, patients may be surviving only until admitted as inpatients. NHAMCS inpatient mortality data are available only after 2005, but—consistent with previous literature[10]—we found no significant upward trend in inpatient mortality to support this notion.

Second, our findings can be explained at least in part by the increasing role of palliative care, which results in more patients' dying in hospice settings outside acute care hospitals and EDs than in the past[11]—which seems a more likely explanation than the previous one. In fact, patients are increasingly receiving home hospice care, and between 1989 and 2007 there was an increase of more than 50 percent in the proportion of home deaths and a 20 percent decrease in

EXHIBIT 3

Estimated emergency department (ED) visits by US adults ages 18 and older by patient characteristics, 1997 and 2011

	Estimated ED visits									
	Unweighted no.		Weighted no. (millions)		Per 1,000 adults					
Characteristic	1997	2011	1997	2011	1997	95% CI	2011	95% CI	Difference	95% CI
Age (years)										
18–44	9,453	12,876	40.2	56.6	361.6	306.1, 417.2	499.2	418.8, 579.5	137.6****	40.0, 235.2
45–64	3,654	6,901	15.6	29.8	277.7	236.1, 319.3	360.3	304.5, 416.1	82.6****	13.0, 152.2
65–79	2,134	2,771	9.2	12.0	357.0	299.4, 414.6	400.9	334.0, 467.8	43.9***	−44.3, 132.1
80 or older	1,278	1,918	5.6	8.4	649.9	537.7, 762.1	728.6	602.1, 855.0	78.7**	−90.3, 247.7
Sex										
Female	8,971	13,734	38.7	60.7	370.0	314.4, 425.7	496.5	417.2, 575.8	126.5****	29.6, 223.4
Male	7,548	10,732	31.9	46.2	328.3	279.0, 377.6	399.9	338.2, 461.6	71.6****	−7.3, 150.5
Race/ethnicity										
Non-Hispanic white	11,024	15,225	49.9	66.9	346.0	287.3, 404.7	443.9	366.3, 521.4	97.9****	0.64, 195.2
Non-Hispanic black	3,534	5,071	14.0	24.0	586.6	459.3, 713.8	820.6	622.0, 1,019.2	234.0****	−1.80, 469.8
Hispanic	1,493	3,110	5.1	12.8	238.3	188.6, 288.0	323.5	258.3, 388.6	85.2****	3.4, 167.0
Other	468	1,060	1.5	3.1	181.1	130.7, 231.4	173.9	116.7, 231.2	−7.2	−83.4, 69.0
Insurance[a]										
Private	5,566	6,861	25.0	30.0	177.8	148.9, 206.8	195.7	162.3, 229.2	17.9	−26.3, 62.1
Medicare	3,263	5,626	14.3	24.8	405.1	339.2, 471.0	534.6	442.6, 626.6	129.5****	16.4, 242.6
Medicaid	2,366	5,088	9.2	21.1	646.2	540.2, 752.1	863.4	710.3, 1,016.4	217.2****	31.0, 403.4
Uninsured	3,014	4,311	12.9	20.0	394.5	321.7, 467.3	481.4	394.0, 568.7	86.9	−26.8, 200.6
Other	1,320	985	5.2	0.7	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]
Missing or unknown	970	1,595	4.0	6.4	—[b]	—[b]	—[b]	—[b]	—[b]	—[b]

SOURCE Authors' analysis of data for 1997 and 2011 from the National Hospital Ambulatory Medical Care Survey. **NOTES** Adult denominator population estimates for age, sex, race/ethnicity, and insurance come from the US Census Bureau. To assess the significance of changes in ED visit rates over the entire observation period for these variables, we conducted trend tests using weighted least squares regression models; details are available in the Appendix (see Note 4 in text). CI is confidence interval. Significance refers to the entire study period. [a]Per 1,000 adult insurance enrollees. [b]Denominator estimates unavailable. **$p < 0.05$ ***$p < 0.01$ ****$p < 0.001$

EXHIBIT 4

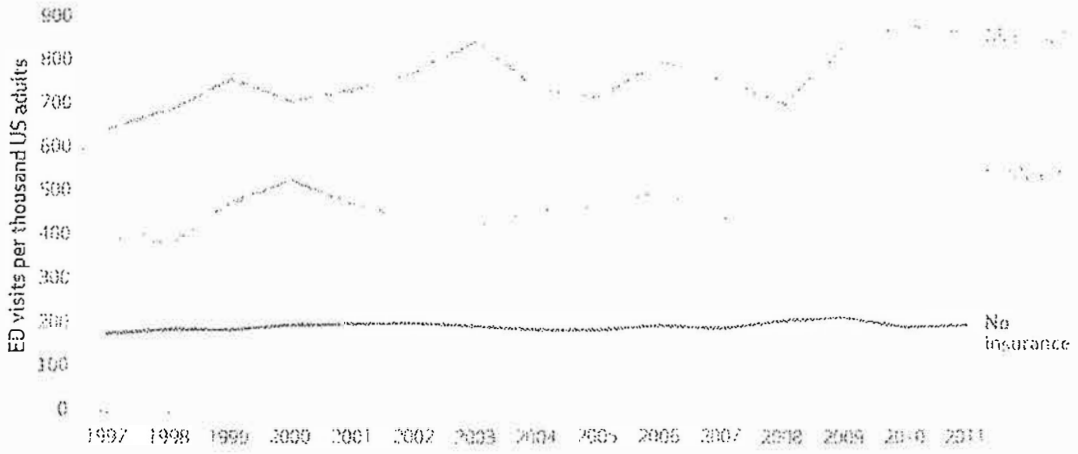
Characteristics of emergency department (ED) visits by US adults ages 18 and older, 1997 and 2011

	Unweighted no.		Weighted no.		Percent of estimated ED visits			
Characteristic	1997	2011	1997	2011	1997	95% CI	2011	95% CI
Triage category****								
Immediate or emergent	3,656	3,149	16.0	14.1	22.7	19.7, 25.7	13.2	11.5, 14.8
Urgent	5,249	11,082	22.3	48.4	31.6	28.8, 34.4	45.3	42.8, 47.7
Semi-urgent or nonurgent	4,025	9,563	16.8	42.0	23.8	20.6, 27.0	39.4	36.6, 42.2
No triage or unknown	3,589	672	15.4	2.4	21.8	17.8, 25.8	2.2	0.5, 3.9
Region								
Northeast	4,086	5,262	14.7	19.8	20.8	15.5, 28.1	18.5	12.9, 24.1
Midwest	4,035	6,082	18.4	24.2	26.2	19.4, 32.9	22.7	16.0, 29.3
South	5,199	7,545	24.2	42.1	34.3	27.1, 41.6	39.4	31.5, 47.3
West	3,199	5,577	13.2	20.8	18.7	12.6, 24.9	19.4	13.9, 25.0
Metropolitan Statistical Area								
Urban	13,877	21,265	54.3	90.3	76.9	67.6, 86.1	84.5	76.0, 93.0
Rural	2,642	3,201	16.3	16.6	23.1	13.9, 32.4	15.5	7.0, 24.0

SOURCE Authors' analysis of data for 1997 and 2011 from the National Hospital Ambulatory Medical Care Survey. **NOTES** To assess the significance of changes in percentage of estimated ED visits over the study period for triage category, geographic region, and Metropolitan Statistical Area, we conducted weighted chi-square tests for trend; details are available in the Appendix (see Note 4 in text.) Significance refers to the entire observation period. CI is confidence interval. ****$p < 0.001$

EXHIBIT 5

Trends in emergency department (ED) visit rates, by insurance category



SOURCE Authors' analysis of data for 1997–2011 from the National Hospital Ambulatory Medical Care Survey. NOTES ED visit rates are per thousand US adults ages eighteen and older with the respective types of insurance. Appendix Exhibit 2 (see Note 4 in text) is a table containing pertinent data points, standard errors, confidence intervals, and other statistical data for this exhibit.

the proportion of hospital deaths.[12]

Third, withholding or terminating resuscitation efforts in the prehospital setting could also contribute to the reduction in ED mortality. During the study period, several professional societies published guidelines for prehospital termination of resuscitation, and many cities initiated policies that allowed paramedics to forgo resuscitation efforts in certain cases of cardiac arrest.[13] A drop in ED mortality could be the result of patients with cardiac arrest—who previously would have been transported to and declared dead in the ED—no longer being transported to the hospital. However, continued financial, legal, and societal pressures to transport patients have limited the widespread adoption of such termination of resuscitation guidelines and policy changes.[13] Thus, the degree to which changes in resuscitation policies contribute to ED mortality nationally remains unclear.

Fourth, ED visit rates increased substantially for both Medicaid and Medicare beneficiaries. While these populations tend to be sicker and to have poorer access to ambulatory care, compared to the overall national adult population,[14] they did experience improvements in quality and access outcomes during the study period.[15,16] We also found an increase in ED visits by nonelderly adults and an increase in low-acuity ED visits. However, since we present our mortality results per thousand adults (not per total ED visits), our findings cannot be explained by an increase in the proportion of low-acuity visits.

Fifth, improvements in emergency medicine and public health could also help explain the drop in ED mortality. In recent decades, substantial advances have occurred in the acute management of life-threatening conditions such as myocardial infarction, stroke, trauma, and sepsis.[17] Such advances include improved medical therapies, the regionalization of acute medical and trauma care, and enhanced critical care training of prehospital personnel and emergency physicians.

NHAMCS does not provide data on the actual cause of death, and thus many patients in our study were characterized as having suffered from nonspecific cardiac arrest. Managing patients with undifferentiated cardiac arrest is common in the ED, and recent advancements in the care of such patients could also have contributed to our results. However, the NHAMCS data did not allow us to comment on national trends in survival after cardiac arrest. Measuring such survival rates would require a centralized national registry that tracked incidence, interventions, and outcomes, as called for in an Institute of Medicine report on cardiac arrest survival.[18]

Sixth, there have also been continued public health achievements—for example, progressive improvements in smoking cessation and motor vehicle safety—that contributed to downward trends in mortality across the entire US population during the study period, which could be reflected in our data.[19]

Conclusion

The etiology behind the nearly 50 percent reduction in ED mortality is likely multifactorial. Fur-

ther research is needed to delineate the underlying causative factors. Describing changes in ED mortality can help improve understanding of the impact that recent advances in palliative, prehospital, and emergency critical care have had on the locus of death in the United States.

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4 To access the Appendix, click on the Appendix link in the box to the right of the article online.

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